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Original Article

A Taxonomy of the Common Tasks and the Development of a Risk Index for Physical Load Assessment in Nursing Job

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ABSTRACT

Background: Nursing service is a nonroutine work with an excessive physical load and diverse tasks. This study derived representative common tasks based on the frequently occurring tasks with a high physical load in the nursing workers' daily work and developed indicators to evaluate the work risk by reflecting the characteristics of nonroutine work.

Methods: Common tasks were classified through the following stages: literature review, first focus group interview (FGI) with experts, first classification of common tasks, second FGI with hospital health managers, a survey of nursing service workers, and the final classification of common tasks for each task type. To develop an objective risk index for physical load assessment, we investigated the frequency and duration of the derived common tasks via survey.

Results: Nursing common tasks were categorized into six task types and 56 subtasks. To evaluate the risks of various tasks in nonroutine works, three frequencies and three working time levels were defined by examining the task frequency and working hours. Exposure time was defined to reflect the characteristics of a nonroutine job. The final risk assessment was the product of the exposure time level and job intensity level. From this, four risk action levels were derived.

Conclusion: This study has the advantage of solving the problem of focusing on some tasks in evaluating the physical load. It was meaningful in that a new risk assessment index based on exposure time was proposed based on the development of an evaluation scale for frequency and time by reflecting the characteristics of nonroutine work.

1. Introduction

Nursing service workers' primary job is to provide medical services to patients with various needs. Various specialists, including doctors, medical technicians, and administrative staff collaborate to provide these services [1]. Given these occupational characteristics, nursing work entails more physical job stress than other jobs. A high level of physical job stress induces mental exhaustion and fatigue and contributes in safety accidents and illnesses at work [2]. Many studies investigating the major causes of musculoskeletal disorders emphasize physical job stress [3–5]. The major causes of musculoskeletal diseases include the excessive use of force, inappropriate posture, and repetitive movements [6]. The proportion of nursing service workers with a musculoskeletal disease among all industrial accident-induced diseases is high compared to other jobs because they experience an excessive physical load while caring for and treating patients with difficulty in walking.

Nurses are especially at high risk for musculoskeletal diseases (MSDs) due to their physically demanding jobs. A previous study reported a 37% prevalence of MSDs among general workers, which was as high as 92% among nursing professionals [7]. The prevalence of MSDs may vary between 33.0% and 88.0% among nurses worldwide [8,9]. According to the reports of industrial accidents in Republic of Korea in the last 3 years, about 60 nurses reportedly had job-related diseases. Among those, the majority (78%) had MSDs [10]. Various previous studies have reported that musculoskeletal disorders constitute a high proportion of job-related diseases

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Table 1
Basic information of the experts who participated in the FGI

No.	Role	Affiliation	Experience	Size	Number of people
First FGI					
1	Health administrator	A University Hospital	21	Large hospital	1
2		B Hospital	22	Large hospital	1
3	Nurse	C Hospital	15.4 (Mean)	Large hospital	4
4		D Hospital	8.2 (Mean)	Small-to-midsize hospital	4
5	Professor	E University	10.5 (Mean)	—	2
6		F University	8.5 (Mean)	—	2
7	Researcher	G Research Institute	15 (Mean)	—	2
Total					16
Second FGI					
1	Health administrator	H University Hospital	18	Small-to-midsize hospital	1
2		I University Hospital	19	Large hospital	1
3		J Medical center	24	Small-to-midsize hospital	1
4		K Hospital	10	Small-to-midsize hospital	1
5		L Hospital	22	Large hospital	1
Total					5

experienced by nursing service workers and show an increasing trend every year [11–13].

Nurses' studies of MSDs were focused on examining body parts with heavy physical loads during work. In most studies, nurses reported high physical burden and MSD complaints on the lower back, knee, and neck [14–16]. In addition, evaluation studies related to musculoskeletal disorders in nursing occupations were conducted with a focus on patient handling [17–19].

To investigate and assess the risk factors of musculoskeletal disorders beforehand for prevention, the Industrial Safety and Health Act requires an ergonomic job hazard analysis to be performed in Republic of Korea [20]. The ergonomic job hazard analysis assesses jobs based on 11 tasks with physical loads defined in the Employment and Labor Notice 2018-13 [21]. This standard was defined based on the task's exposure time, exposure frequency, body part, posture, task content, and the object's weight. This was developed by benchmarking the Washington State Ergonomic checklist [22,23] to make it appropriate for application to routine jobs such as manufacturing jobs. However, the tasks performed by nursing service workers are nonroutine and diverse [24]. Therefore, the reliability of the results obtained using the 11-task ergonomic checklist, which was developed to assess routine jobs, to assess the musculoskeletal hazards of nursing work is low. Particularly, akin to nursing work, it is difficult to assess physically demanding jobs with irregular type, intensity, and frequency of tasks as a job with a high musculoskeletal load.

Nonroutine jobs have a high variance in task frequency, working time, and task form. They have no job cycles, and the specific duration of activities cannot be easily predicted [25]. Therefore, because nonroutine jobs have more complex and diverse types of job patterns and job motions compared to routine jobs, a tool for assessing the risk factors of musculoskeletal disorders is necessary. Gold et al [25] recommended the job sampling method as an approach for deriving the exposure time level from routine jobs and nonroutine jobs that are comparable without deviations.

Fiedler et al [24] stated that it was necessary to analyze various tasks in nursing work because of their diversity and nonrepetitive nature, and criticized the previous studies that assessed high musculoskeletal loads concerning patient handling only. In their study, they performed video analyses, through which they grouped the nursing tasks and calculated the percentage (%) of the working time. Since nursing work comprises very diverse tasks, it is necessary to perform an objective risk assessment to evaluate the musculoskeletal load of the job. Only a few studies have mentioned that nursing work is deeply related to MSDs. Serranheira et al [26] mentioned problems with patients transferring and heavy lifting tasks, and Brophy et al [27] classified tasks with high physical loads into laundry bags, food trays, push-or-pull objects such as wheelchairs, stretchers, food service trays, laundry carts. Fiedler et al [24] investigated nursing tasks by classifying them into charting and documentation tasks, housekeeping tasks, medicine preparation tasks, nurses care tasks, patient care tasks, patient moving and transfer tasks.

Given the nonroutine nature and diversity of the tasks, it is difficult to find research that defines common tasks in nursing work. Furthermore, no instrument has been developed to clearly assess the tasks that involve musculoskeletal loads in the nursing profession, which is a typical nonroutine profession. Therefore, this study aimed to derive representative common tasks based on the tasks that occurred most frequently with a considerably high physical load in the daily work of nursing service workers (study 1). Additionally, we aimed to develop indicators to evaluate the risk of work by reflecting the characteristics of nonroutine work (study 2).

2. Methods

2.1. STUDY 1: Classification of common tasks performed by nursing service workers

In this study, the nursing service workers were limited specifically to nurses, nurse's aides, and patient transporters. Caretakers and caregivers were excluded because they differed from nursing service workers employed at general hospitals regarding their job characteristics and because they are subsumed under a different classification in the Korea Standard Occupational Classification. The common tasks defined in this study included tasks that occurred every day during work, occurred most frequently among daily tasks, and involved handling physical load.

All the participants provided informed consent before participation as per the requirement of the Institutional Review Board of the affiliated university (No. CUPIRB-2019-064).

The classification of common tasks in nursing was largely conducted in the following stages: (1) literature review; (2) first focus group interview (FGI) conducted with experts (including university professors, health administrators in hospitals, nurses, specialists in human factors, and ergonomics specialists); (3) first classification

Table 2
Classification of common tasks performed by nursing service workers

Type	Common subtasks	Figure
1. Man-powered tasks of handling patients	1.1 Changing the patient's posture	
	1.2 Patient transfer (to laboratory, therapy room and outpatient ward, etc.)	
	1.3 Measuring a patient's height and weight (biometrics)	
	1.4 Supporting a patient's posture	
	1.5 Assisting with walkers or wheelchairs	
	1.6 Patient hygiene care (bowels)	
	1.7 Applying body guard	
	1.8 Assisting a patient in exercise	
	1.9 Transferring a patient between beds	

Type	Common subtasks	Figure
2. Man-powered tasks of transporting/handling goods, equipment, etc.,	2.1 Transporting/handling a box of fluids and fluids (including hanging the fluid)	
	2.2 Transporting/handling vitals equipment	
	2.3 Transporting/handling oxygen cylinders	
	2.4 Transporting/handling drug carts	
	2.5 Transporting/handling hampers	

(*continued on next page*)

Table 2 (*continued*)

Type	Common subtasks	Figure
	2.6 Transporting/handling medical equipment	
	2.7 Transporting/handling equipment other than medical equipment	
	2.8 Transporting/handling products (needles, expendables, office supplies, waste, etc.)	
	2.9 Transporting rolling beds and wheelchairs	
	2.10 Managing bedside equipment (oxygen cylinder, suction canister replacing)	
	2.11 Managing linen room	
	2.12 Controlling angle and height of the bed	

Type	Common subtasks	Figure
3. Tasks for helping patients' daily lives	3.1 Bathing patients	
	3.2 Washing patients' hair	
	3.3 Oral care	
	3.4 Dressing (including during injection)	
	3.5 Feeding (medicating) the patient	
	3.6 Assisting patients in critical condition with eating (tube-feeding)	
	3.7 Replacing diapers	

Table 2 (*continued*)

Type	Common subtasks	Figure
	3.8 Replacing bedding	
	3.9 Issuing and organizing plates	
	3.10 Emptying urine bags	
	3.11 Traction therapy	
	3.12 Assisting with using the restroom	

Type	Common subtasks	Figure
4. Medical exams or treatments on the patients	4.1 Checking patient condition (vital check, etc.),	
	4.2 Suction	
	4.3 Injecting (intravenous injection, intramuscular injection, etc.)	
	4.4 Wound care (dressing, bedsore, tracheostomy)	
	4.5 Managing drainage tubes	
	4.6 Mixing injections	
	4.7 Drawing blood	
	4.8 Managing catheters (urine bag, simple catheter)	

(*continued on next page*)

Table 2 (*continued*)

Type	Common subtasks	Figure
	4.9 Cardiopulmonary resuscitation (CPR) (Assisting)	
	4.10 Artificial Manual Breathing Unit (AMBU) (Assisting)	
	4.11 Providing technical assistance while wearing lead aprons	

Type	Common subtasks	Figure
5. Computer and administrative tasks	5.1 Computer work	
	5.2 Answering phones	
	5.3 Completing forms (writing)	

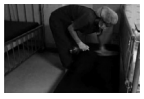
Type	Common subtasks	Figure
6. Other tasks (cleaning, organization, etc.)	6.1 Washing equipment (antiseptic goods, medical equipment)	
	6.2 Cleaning the ward (removing blood, removing contaminants and foreign substances)	
	6.3 Replacing curtains and blinds	
	6.4 Organizing and cleaning beds	
	6.5 Organizing and wrapping medical waste	
	6.6 Organizing and cleaning nursing stations	
	6.7 Organizing and cleaning the treatment room	

Table 2 (*continued*)

Type	Common subtasks	Figure
	6.8 Organizing and cleaning drug carts	
	6.9 Recycling after treatment and organizing products	

of common tasks; (4) second FGI conducted with hospital health managers; (5) a survey of nursing service workers; and (6) the final classification of common tasks for each task type.

For this review, a systematic search was conducted using PubMed, Elsevier Science, ScienceDirect databases, and Google Scholar for studies published from 1980 to 2019. The procedure of the literature review comprised six steps: choosing the databases, searching the keywords, reviewing the title, reviewing the abstract, selecting the related papers, and reviewing/arranging tasks. The search was restricted to papers published in English and containing the terms “nursing,” “nursing tasks,” “hospital task,” “nursing occupations,” “nurse tasks,” “musculoskeletal disorder,” “nursing postures,” “common task,” or “nursing works” in the title, abstract, or keywords. The initial database search yielded about 210 results. After reviewing the titles and abstracts to reject duplicated articles, 120 articles were selected. After applying inclusion and exclusion criteria, 45 articles related to nursing tasks were selected using a manually targeted search. In total, 45 articles were included in the current review. Furthermore, the hazardous factors reports completed by five large hospitals as per the Industrial Safety and Health Act in Republic of Korea were reviewed.

For the first classification of the common tasks of the nursing service workers, the FGI was conducted 4 times with 16 members comprising two health administrators in large university hospitals, eight nurses in university hospitals, four professors in the department of nursing in S University, and two human factors or ergonomics specialists with experience in ergonomic job hazard analysis in hospitals. The common tasks obtained from the 16 experts were re-grouped based on the task types to produce the first classification of the common tasks of nursing service workers.

To revise and supplement the first list of common tasks, the aforementioned FGI was conducted on health administrators who actually manage musculoskeletal disorders in hospitals. The second FGI was conducted 5 times on five health administrators. The health administrators who participated in the first FGI were excluded in the second FGI. Table 1 shows the basic information about the experts who participated in the first and second FGIs. The average length of experience of the experts who participated in the first and second FGIs was 14.37 and 18.60 years, respectively.

Based on the common tasks derived from two rounds of FGIs with experts, surveys were distributed to nursing service workers in nine hospitals to assess the derived common tasks. The contents of the surveys were structured to verify the common tasks derived from the first and second FGIs and to add tasks that occurred daily during work, occurred most frequently among daily tasks, and induced physical load. About 50 surveys were distributed to each of the 5 small-to-midsize hospitals and four large hospitals. Out of 450, 335 surveys were returned, reflecting a return rate of 74.4%.

Based on the results of the previously stated five stages of classification of common tasks, the final classification of common tasks by task type was prepared.

2.2. STUDY 2: Development of a risk index for physical load assessment

The risk index for quantitative physical load assessments generally consider the posture, strength, repetitiveness, contact stress, load experienced due to the task duration, and task frequency in nursing service work. However, although determining the standard of the levels used for each variable significantly affects the sensitivity of the outcomes, the standards of levels for task frequency and working time are not clear. Most existing standards apply to routine jobs. Therefore, applying the standards of task frequency and duration that are used in typical risk assessments to nursing occupations, which is a nonroutine job, can result in very low sensitivity of assessment. Therefore, in study 2, surveys were conducted to determine the frequency levels, working time, and exposure time of the tasks based on the common tasks of the nursing service workers derived in Study 1.

Nurses, nurse's aides, and patient transporters who participated in Study 1 were surveyed. In all, data were obtained from 335 participants. Participants comprised 299 women and 36 men. The participants' average work experience and average working hours per day were 8.0 (SD 8.3) years and 8.9 (SD 0.9) hours, respectively. Based on their jobs, 335 participants completed the surveys about the 56 common tasks derived from Study 1. Based on this, the total number of 10,117 sample tasks were obtained. Therefore, it can be inferred that each person performed a mean of 30.2 tasks out of the 56 common tasks derived in Study 1.

The procedure to distinguish the frequency levels based on the frequency data that were organized through the surveys is described. The levels were determined based on the overall distribution of the collected data. First, among 10,117 sample tasks derived from the surveys, data on the frequency of each task per day were listed in ascending order. Then, outliers were eliminated using the three-sigma rule. Next, based on the frequency value, the data were represented in quartiles that show the median and maximum values of the mean task frequency per day.

The standard working time was defined as the length of time (minutes) needed for one session of the given task. First, among 10,117 sample tasks derived from the surveys, data on the length of time needed for one session of the task was listed in ascending order. Then, outliers were eliminated using the three-sigma rule. Next, based on the length of time needed for one session of the task, the data were represented in quartiles to show the median and maximum values of the mean working time.

Finally, the level for exposure time was defined as follows. The jobs including data with outliers in the frequency and working time

were excluded. The frequency level and working time level defined above were applied to the frequency of the task per day and the time needed for one session of the task, respectively. The two levels were then multiplied.

3. Results

3.1. STUDY 1: Classification of common tasks performed by nursing service workers

The task types derived in the first classification of common tasks were: (1) man-powered tasks of handling patients; (2) man-powered tasks of transporting/handling goods, equipment, etc.; (3) tasks of helping patients in their daily lives; (4) medical acts enacted on patients; (5) administrative tasks; (6) others (cleaning, organization, etc.). The numbers of common subtasks in each of the six task types were 5 (changing the patient's posture, patient transfer, measuring patients' weight, supporting patients' posture, and holding the walker), 11 (transporting/handling boxes of fluids, vital equipment, oxygen tanks, drug carts, hampers, other equipment, and goods, moving empty beds and wheelchairs, replacing suction canisters, replacing bedside oxygen cylinders), 9 (bathing patients, washing patients' hair, oral care, dressing patients, feeding (medicating) patients, assisting patients with using the restroom, changing diapers, replacing bedding, issuing and organizing plates), 6 (checking patient condition (vital check, etc.), suction, injecting, dressing, managing drainage tube, mixing injections), 3 (computer work, answering phones, manual work), and 5 (washing equipment, cleaning the ward, replacing curtains, organizing/cleaning beds, organizing/wrapping waste), respectively. Overall, 39 common tasks were derived.

Based on the first classification of these common tasks, the second FGI conducted with hospital health managers, and surveys of nursing service workers, the final classification of common subtasks according to task type were derived. First, the terms derived in the first classification of common tasks were changed to plain terms commonly used on-site. The final task types were reclassified as follows: (1) man-powered tasks of handling patients; (2) man-powered tasks of transporting/handling goods, equipment, etc.; (3) tasks of helping patients in their daily lives; (4) medical exams or treatments conducted on the patients; (5) computer and administrative tasks; and (6) Other tasks (cleaning, organization, etc.).

Common subtasks by task type were revised and supplemented based on the results from the second FGI and the surveys conducted on on-site nursing service workers. Compared to the results of the first classification of common tasks: (1) four common subtasks were added to man-powered tasks of handling patients; (2) one common subtask was added to man-powered tasks of transporting/handling goods, equipment, etc.; (3) three common subtasks were added to the tasks of helping patients in their daily lives; (4) five common subtasks were added to the medical exams or treatments conducted on the patients; and (5) four common subtasks were added to other tasks (cleaning, organization, etc.); overall 13 subtasks were added. Finally, based on this study, the common task types of the nursing service workers were classified into six types and a total of 56 subtasks were derived (Table 2).

3.2. STUDY 2: Development of a risk index for physical load assessment

3.2.1. Determination of the frequency levels, working time (minute/session), and exposure time

The results of analyzing the frequency value per task based on the collected data showed that the median value of the mean frequency was twice per day and the maximum value was 25 times per day. Fig. 1 shows the frequency distribution of the tasks based on the collected data. Table 3 shows the collected frequency data in quartiles. 25% represents once, 50% represents twice, 75% represents 5 times, and 100% represents 25 times. In other words, about 50% of the investigated common tasks were performed twice or less

Table 3
Quartiles of frequency and frequency levels

% Quartile	Frequency (day)	→	Level	Frequency (day)
25%	1		1	Under 2
50%	2		2	3-5
75%	5			
100%	25		3	Over 6

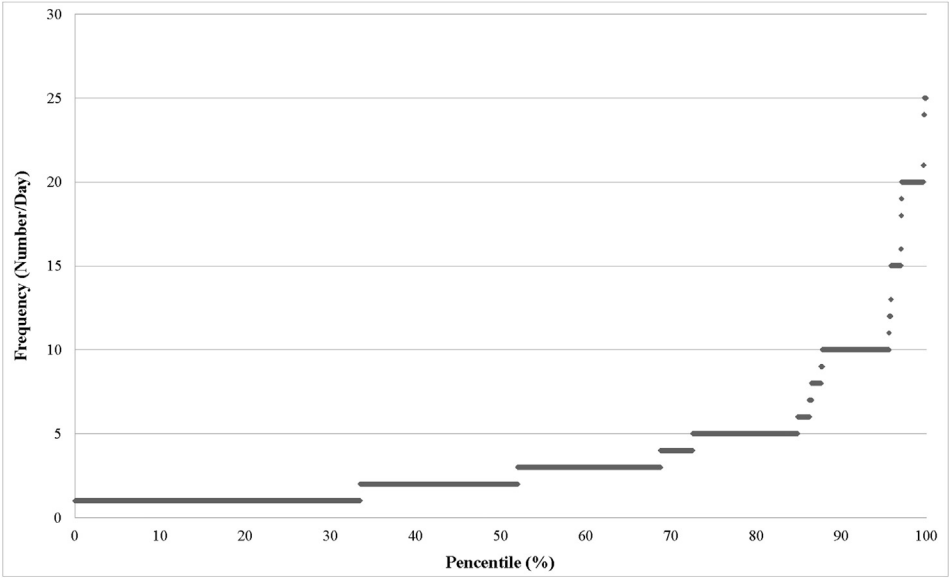


Fig. 1. The proportion of frequency of tasks per day in the collected data.

per day, and about 75% of the data were performed 5 times or less. Therefore, based on the quartiles of the frequency distributions of the investigated common tasks, 3 frequency levels were determined. Level 1 was defined as twice or fewer repetitions of the same task in one day, Level 2 was defined as 3-5 repetitions of the same task in one day, and Level 3 was defined as 6 or more repetitions of the same task in one day (Table 3).

The results of analyzing the values of working time needed for each task session based on the collected data showed that the median value was 5 min per session, and the maximum value was 40 min per session. Fig. 2 shows the distribution of the working time necessary for each task session. Table 4 shows the quartiles of the working time necessary for each task session. About 50% of the investigated common tasks were performed in 5 min or less per session and about 75% of the data were performed in 10 min or less per session (Table 4). Level 1 was defined as less than 5 min working time for each task session, Level 2 was defined as 6–10 min working time for each task session, and Level 3 was defined as over 11 min working time for each task session.

Fig. 3 shows the results obtained by multiplying the frequency level and the working time level, as mentioned above. Consequently, the exposure time level (frequency level × working time level) was equal to 1 for about 53% of the overall data, 2 for about 22%, and 4, 6, and 9 for about 10% each. Based on the above distribution, 5 exposure time levels were defined as shown in Table 5.

3.2.2. Determination of risk index and risk action level

In this study, the 5 (frequency level) × 5 (intensity level) Matrix from the American National Standards Institute/American Society of Safety Engineers (ANSI/ASSE) Z590.3 [28], the most frequently used matrix in risk assessment models, was used as reference to determine the indices. To determine the risk index for assessment, the risk matrix suggested by the ANSI/ASSE was used. Regarding the frequency level, the exposure time level suggested in this study (frequency level × working time level) was applied.

Finally, the product of five exposure time levels and five levels of job intensity (very easy, easy, moderate, difficult, and very difficult) formed the risk index. The risk action level according to the risk index was classified into four classifications of very high, high, moderate, and low as per the standards of ANSI/ASSE Z590.3 [28].

Table 4
Quartiles of working time and working time levels

% Quartile	Min (once)	→	Level	Min (once)
25%	2		1	Under 5
50%	5		2	6-10
75%	10			
100%	40		3	Over 11

4. Discussion

This study aimed to derive the common tasks enacted by nursing service workers, who experience an excessive level of a physical burden compared to other jobs, and to develop a risk index for physical load assessment. Nursing service workers reportedly have a very high rate of exposure to musculoskeletal disorders due to shift and night work, long working hours, and transporting patients. Based on the data on industrial accidents in the United States, nursing service workers ranked third among all jobs with high industrial loss due to industrial accidents. Republic of Korea reflects a similar trend. The ergonomic job hazard analysis conducted as per the Industrial Safety and Health Act has a low implementation rate due to the lack of interest shown by the business owners, difficulty in implementation, and lack of mandated reporting. Even if it is implemented, actual improvement in the work environment does not follow. Particularly, the 11 items on the musculoskeletal ergonomic checklist used in the ergonomic job hazard analysis in Republic of Korea include time and frequency and focuses on assessing routine jobs. Because of this limitation, the ratability of assessment for the nursing profession, which is a typical nonroutine job, is even lower.

The common tasks of the nursing service workers derived in this study were largely classified into six common task types and 56 subtasks. The 56 subtasks derived in this study include tasks with high physical loads and represent tasks performed in daily work. Fiedler et al [24] found that while patient transfers are a main task that induces musculoskeletal disorders, they covered less than 7% of the total working time among all tasks performed by nursing service workers. Through video analyses, they classified the tasks performed by nursing service workers into the following: (1)

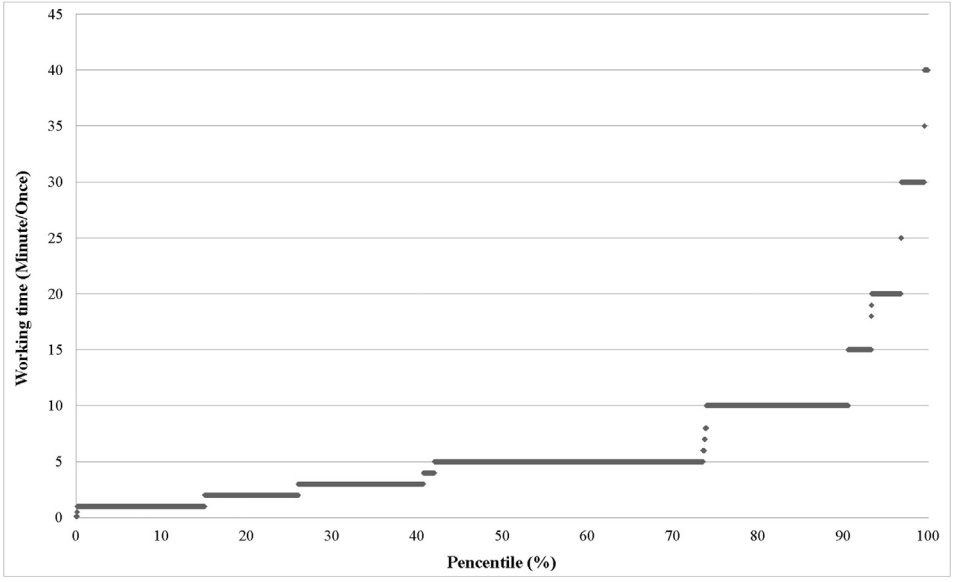


Fig. 2. The proportion of working time per session of task in the collected data.

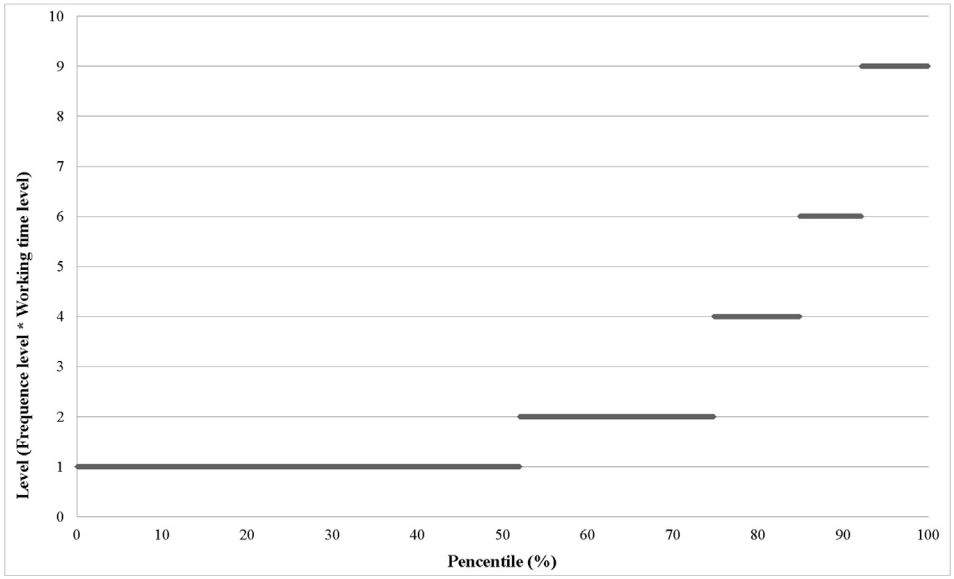


Fig. 3. The proportion of exposure time (frequency level × working time level).

charting and documentation; (2) housekeeping; (3) medicine preparation; (4) nursing service workers care; (5) patient care; (6) patient moving and transfer; (7) sitting; (8) standing; and (9) walking. Among the nine tasks, walking, standing, and sitting tasks comprised 19.8% of the total working time for nursing service workers, followed by charting (14.7%) and patient care (13.9%). In their study, they analyzed the task duration by analyzing videos of nurses. This is difficult to generalize because of differences in the jobs performed by the nursing service workers depending on their roles and departments. As such, the present study has higher reliability because it presents results from studying nursing service workers in various departments in small-to-midsize and large hospitals. Serranheira et al [26] surveyed nurses registered under the Portuguese Nurse Board on the tasks from which they endured any kind of physical load or pain within the past 12 months. The results showed that the common tasks concerning the symptoms included maintenance of patient bed-hygiene, positioning patients in bed, transferring patients, patient holdup, drug administration, domiciliary support, and standing/walking. The common tasks derived in this study included all these tasks.

Studies that assessed or mentioned the musculoskeletal disorders among nursing service workers focused on the job risk factors related to musculoskeletal disorders rather than on common tasks [28–30]. However, most tasks performed by nursing service workers are nonroutine and comprise numerous types of tasks compared to other jobs. Therefore, identifying common tasks before identifying job risk factors is essential. Furthermore, it is necessary to assess the task load based on the common tasks. Given the nonroutine nature and diversity of the tasks, it is difficult to find a research that defines common tasks in nursing work. Furthermore, no instrument has been developed to assess the tasks that involve musculoskeletal loads in the nursing profession, which is a typical nonroutine profession.

Table 5
Exposure time levels

(Frequency level × working time level)	Exposure time level
1	1
2	2
3, 4	3
6	4
9	5

Therefore, this study developed a risk assessment index that can objectively assess the physical load experienced by nursing service workers. Many methods to assess the risk of jobs have been developed and used in various fields. The most frequently used method is the method of determining the action level by calculating the risk score by using the product of the severity and likelihood/frequency variables by level [31–33]. However, the tasks performed by nursing service workers are typically nonroutine and vary highly regarding frequency, duration, and contents of the tasks [25]. Thus, there are problems with using the frequency variables suggested for the risk assessment method for routine jobs.

Therefore, in this study, nursing service workers in small-to-midsize and large hospitals were surveyed about the frequency and working time of the derived common tasks. Based on the collected data, levels were determined according to the distribution of frequency (per day) and working time (per session). Furthermore, based on the frequency and working time, the concept of exposure time was defined. Based on the exposure time, the risk assessment index and action levels were developed.

This study is significant in that it classifies the tasks performed by nursing service workers, which is a typical nonroutine job, in terms of tasks that have the highest physical load and occur most frequently throughout the day. The risk index presented in this study is to evaluate the risks for each task based on the frequency of tasks, time of tasks, and level of intensity. It is believed that the risk index developed in this study can be used to evaluate musculoskeletal disorders in hospitals. In order to use this risk index, it is essential to investigate and use the frequency and time of each operation. However, this study is limited since it does not reflect the tasks performed by nursing service workers employed in nursing and private hospitals. The risk assessment index suggested in this study has the advantage of enabling the preemptive identification of jobs that can induce musculoskeletal disorders because it can assess the tasks of nursing service workers more objectively. However, it is limited in that it does not reflect the individual levels of pain in the assessment. Therefore, future studies should develop a risk assessment index that reflects individual levels of pain. In

Table 6
Risk index and risk action levels in this study

Risk matrix		Level of job intensity				
		Very easy	Easy	Moderate	Difficult	Very difficult
Exposure time level	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5

↓

Risk action levels		
Level	Index	Action
Very high	15-25	Needs immediate action
High	9-12	Needs action as soon as possible
Moderate	5-8	Needs action at an appropriate time after continuous observation
Low	1-4	No need for action

order to verify the working frequency and working time proposed in this study, a verification study will be conducted for hospitals in the future. In a future study, we will carry out a study that performs biomechanical experiments in parallel for high-risk work through this study.

Conflicts of interest

All authors have no conflicts of interest to declare.

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